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Nakano et al.

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(54) **IMAGE FORMING APPARATUS**

(71) Applicants: **Hiroshi Nakano**, Nagoya (JP); **Hirotaka Mori**, Nagoya (JP); **Shougo Sato**, Seto (JP)

(72) Inventors: **Hiroshi Nakano**, Nagoya (JP); **Hirotaka Mori**, Nagoya (JP); **Shougo Sato**, Seto (JP)

(73) Assignee: **Brother Kogyo Kabushiki Kaisha**, Nagoya-shi, Aichi-ken (JP)

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G03G 21/16 (2006.01)
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CPC G03G 21/1633; G03G 21/1647; G03G 21/1623; G03G 21/1676
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See application file for complete search history.

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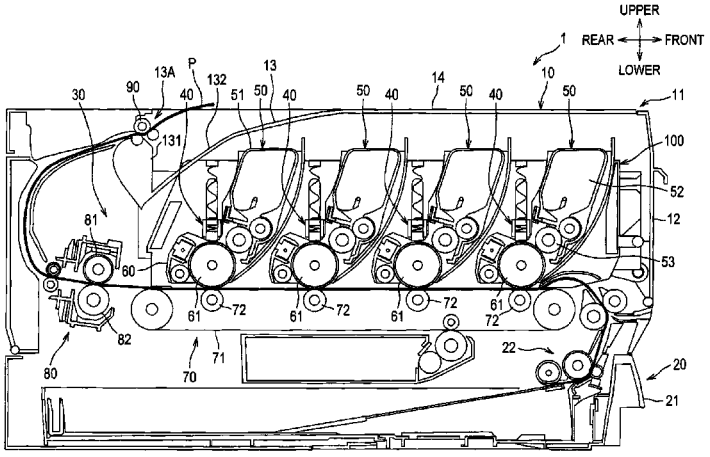
Primary Examiner — Walter L Lindsay, Jr.
Assistant Examiner — Frederick Wenderoth
(74) *Attorney, Agent, or Firm* — Banner, Witcoff, Ltd.

(57) **ABSTRACT**

A photosensitive-drum supporting member has a pair of side walls confronting both ends of each photosensitive drum. The photosensitive-drum supporting member supports the photosensitive drums between the side walls. The photosensitive-drum supporting member moves between: a stowed position at which the photosensitive-drum supporting member is stowed within an apparatus main body; and a moved position at which the photosensitive-drum supporting member is moved from the stowed position to outside the apparatus main body through an opening. Exposing members are provided at the photosensitive-drum supporting member such that the exposing members move between: an exposing position at which each exposing member is adjacent to a corresponding photosensitive drum; and a retracted position at which each exposing member is separated from the corresponding photosensitive drum and is engaged by an engaging part. The exposing members are accommodated within the photosensitive-drum supporting member both at the exposing position and at the retracted position.

18 Claims, 14 Drawing Sheets



(51) **Int. Cl.**
G03G 15/01 (2006.01)
G03G 21/18 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G21/18*** (2013.01); *G03G 2215/0141* (2013.01); *G03G 2221/1636* (2013.01); *G03G 2221/1684* (2013.01)

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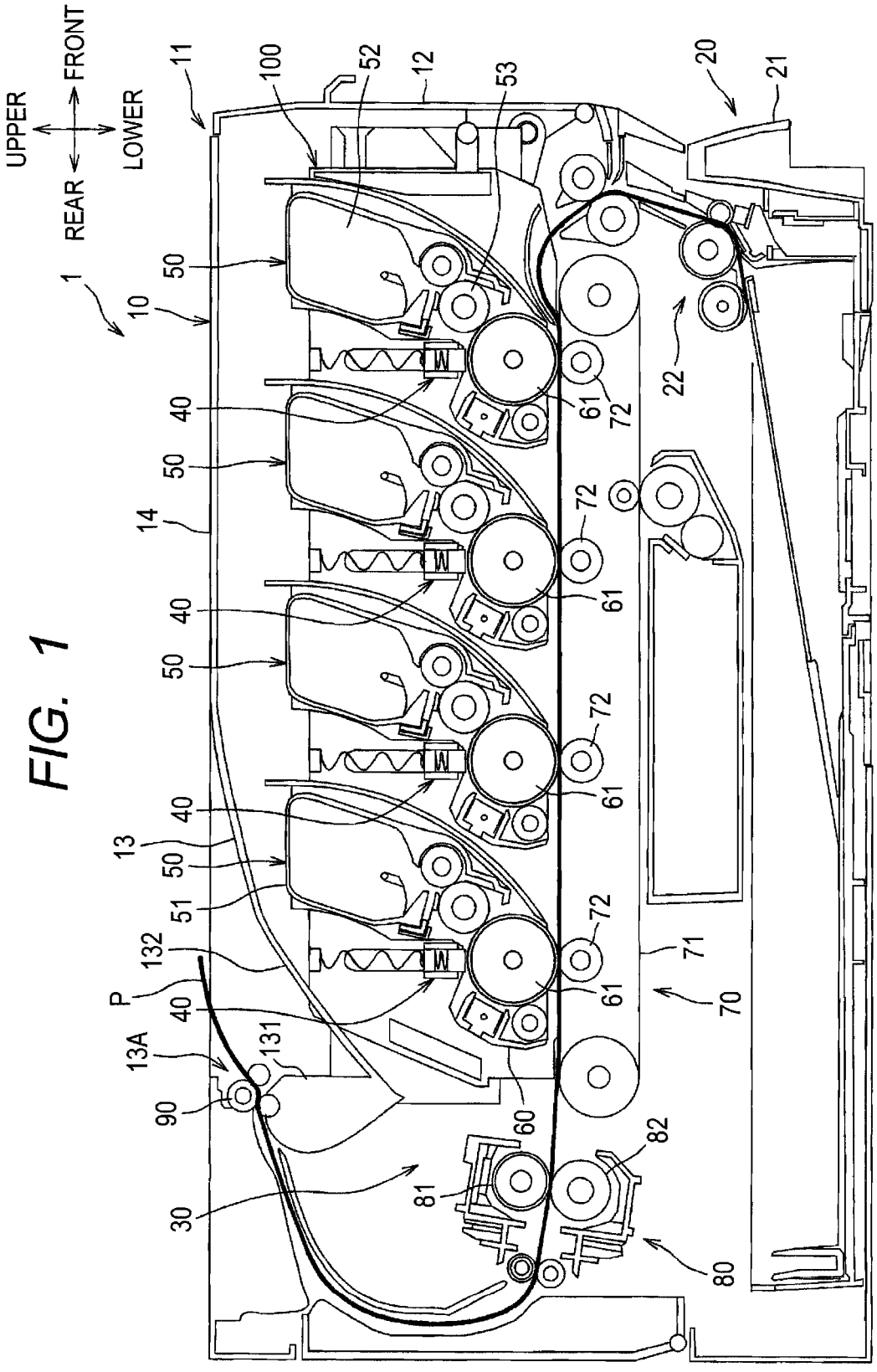
FIG. 1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13A
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22
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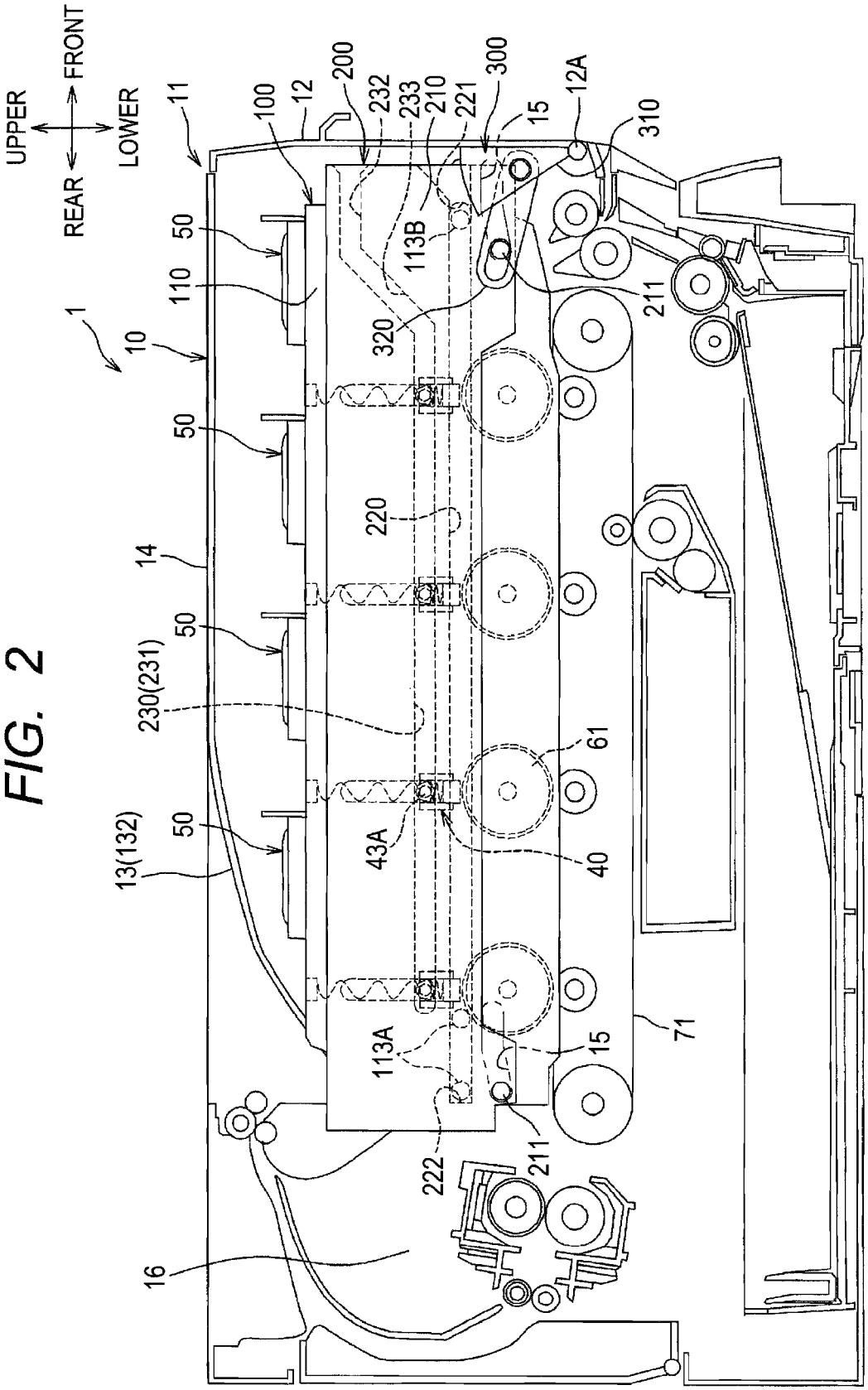
53
60
61
70
71
72
80
81
82
90
100
131
132
P

FIG. 2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12A
310
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113B
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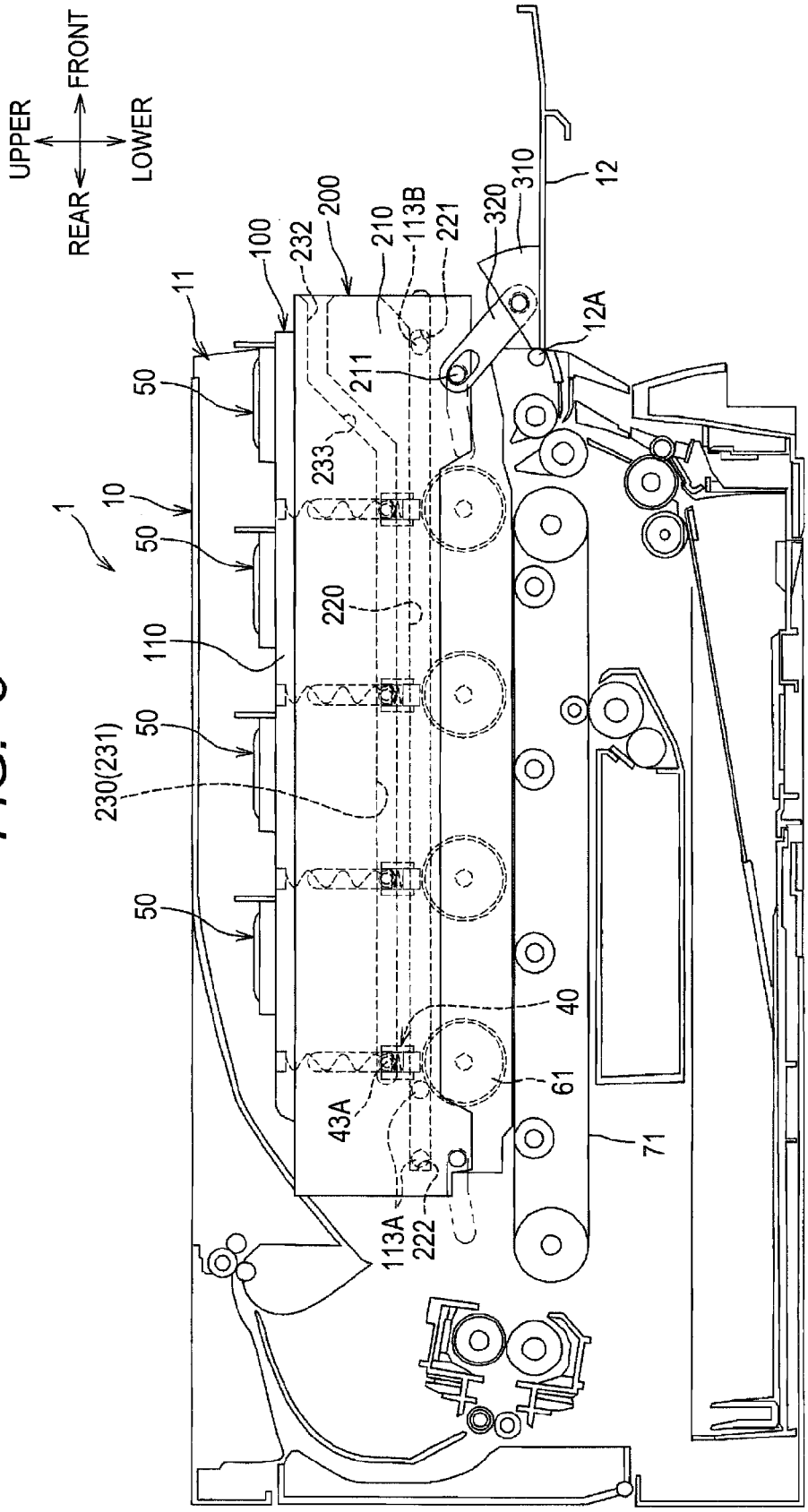
220
14
230(231)
61
13(132)
43A
40
71
113A
222
16

FIG. 3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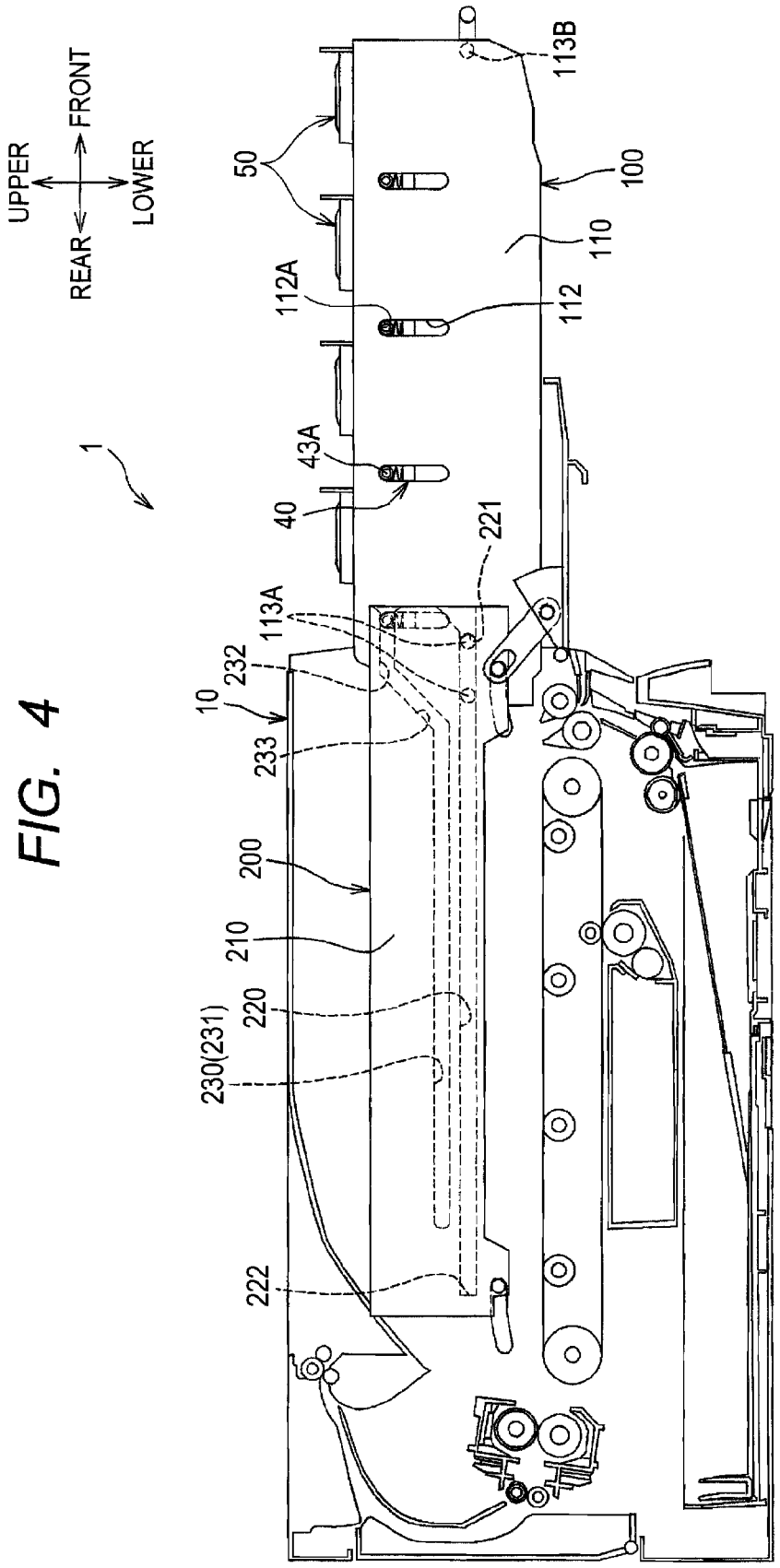
222
230(231)
232
233
310
320

FIG. 4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113B
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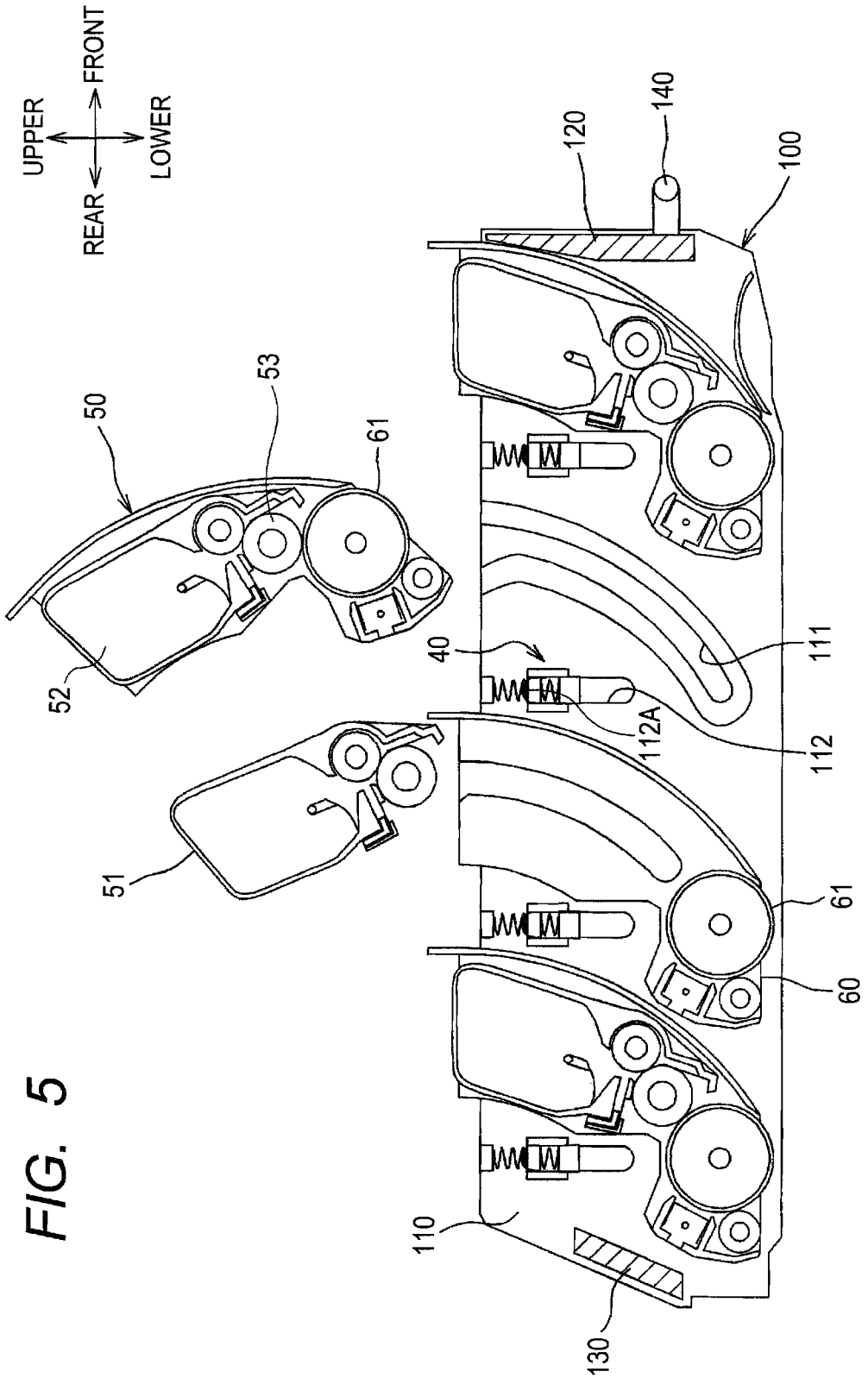
110
112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61
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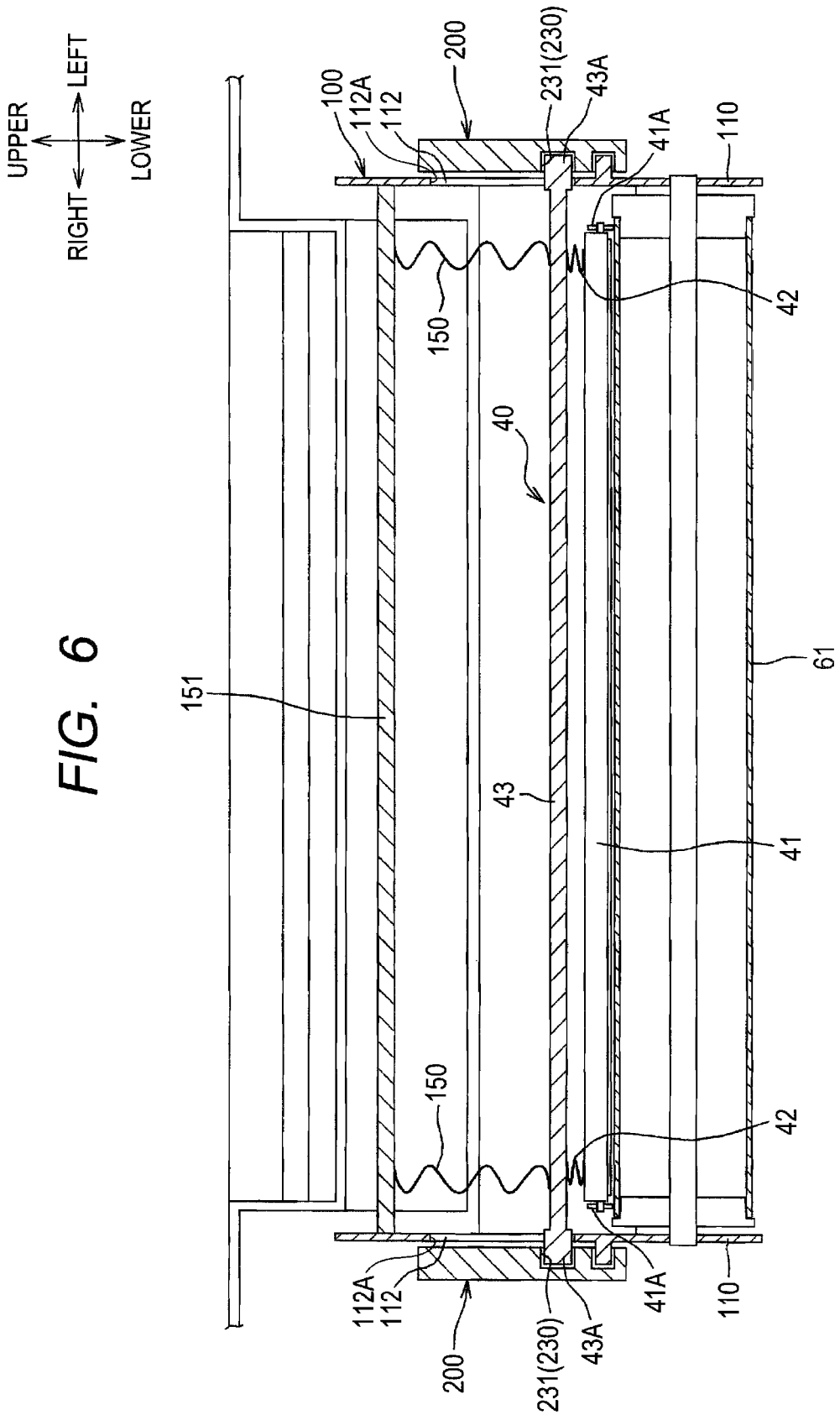
110
130

FIG. 5

FIG. 6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42
112A
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231(230)
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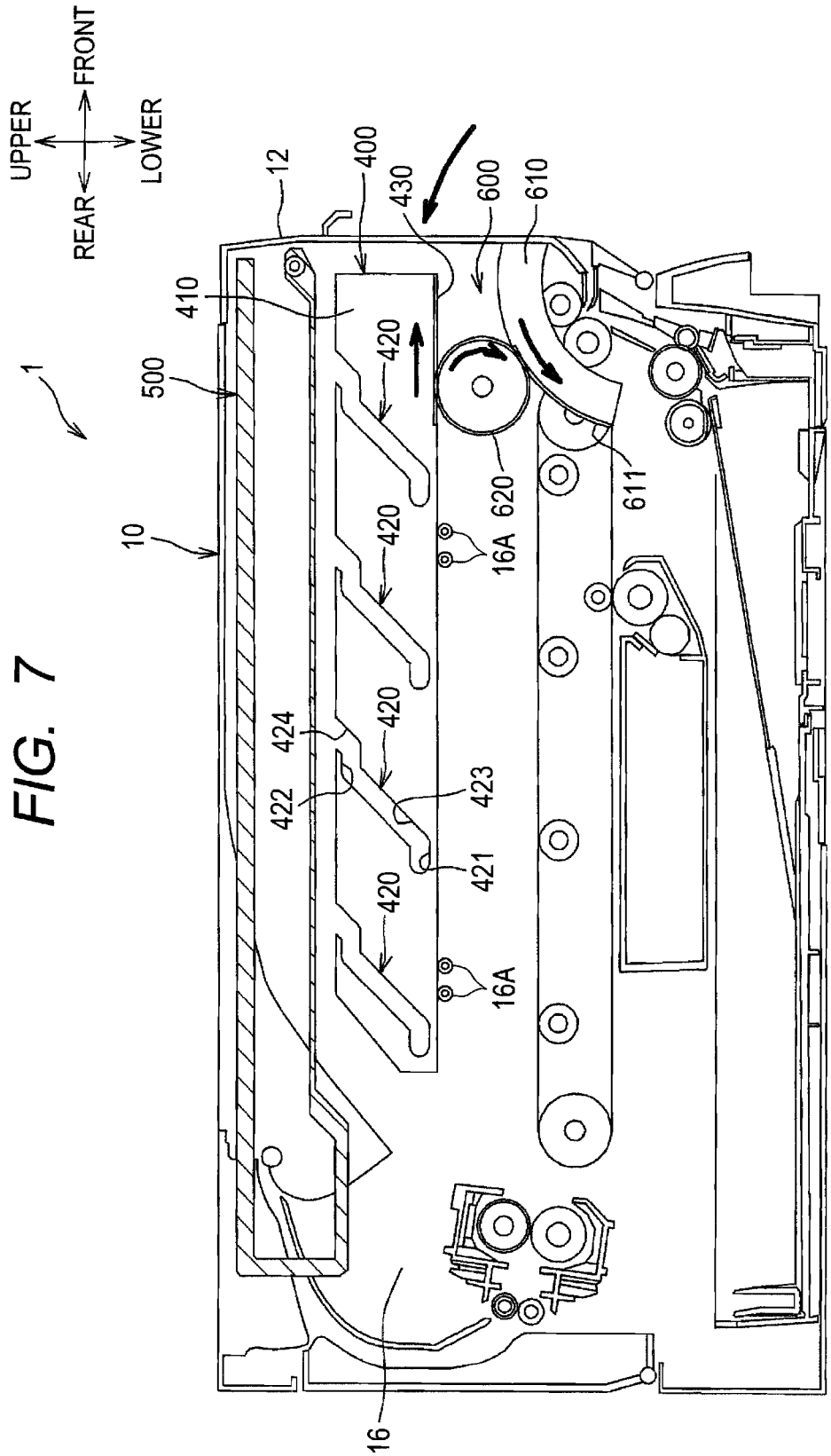
41A
110

FIG. 7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16A
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410
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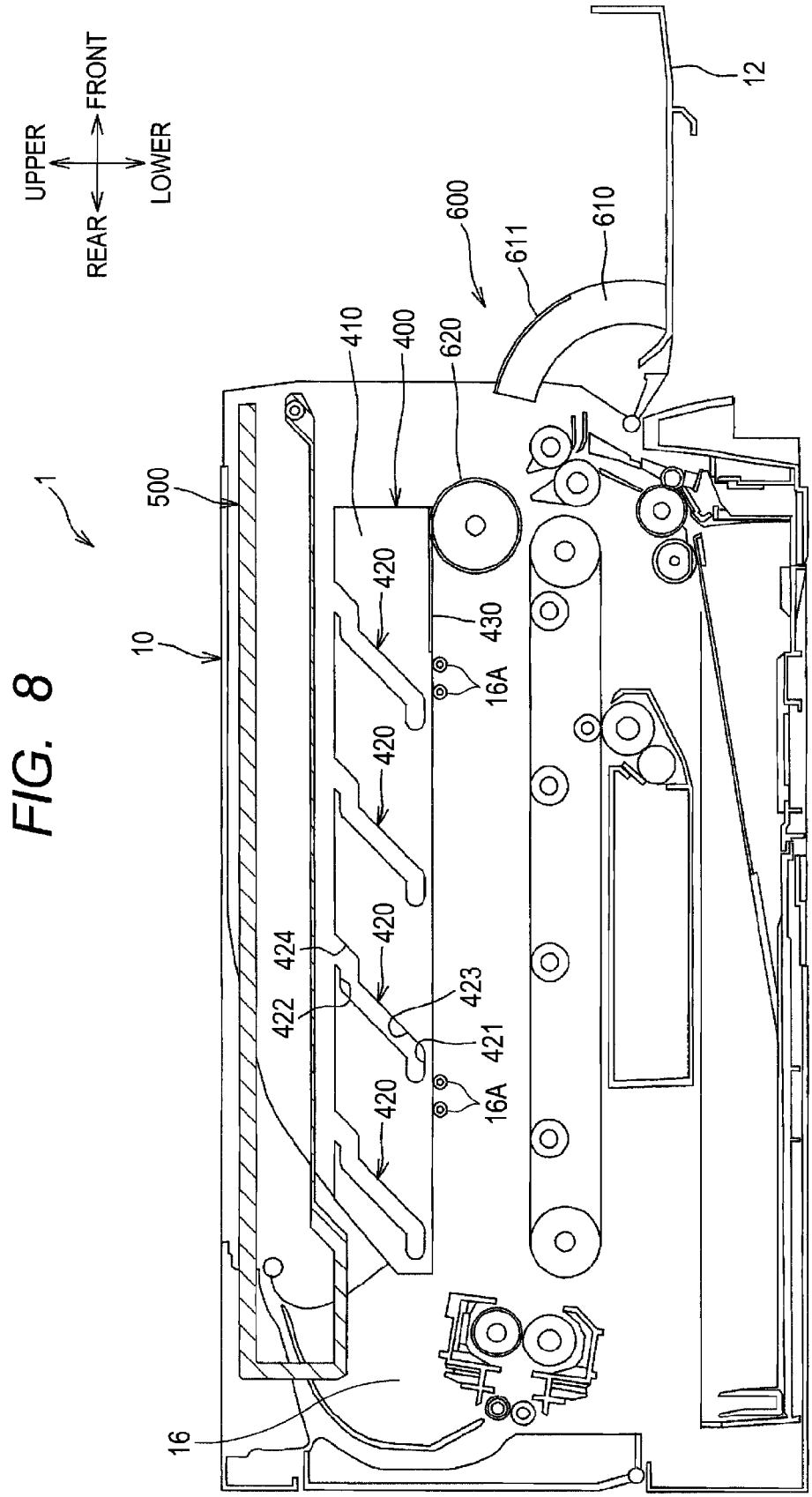
500
600
610
611
620

FIG. 8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600
610
611
620

FIG. 9

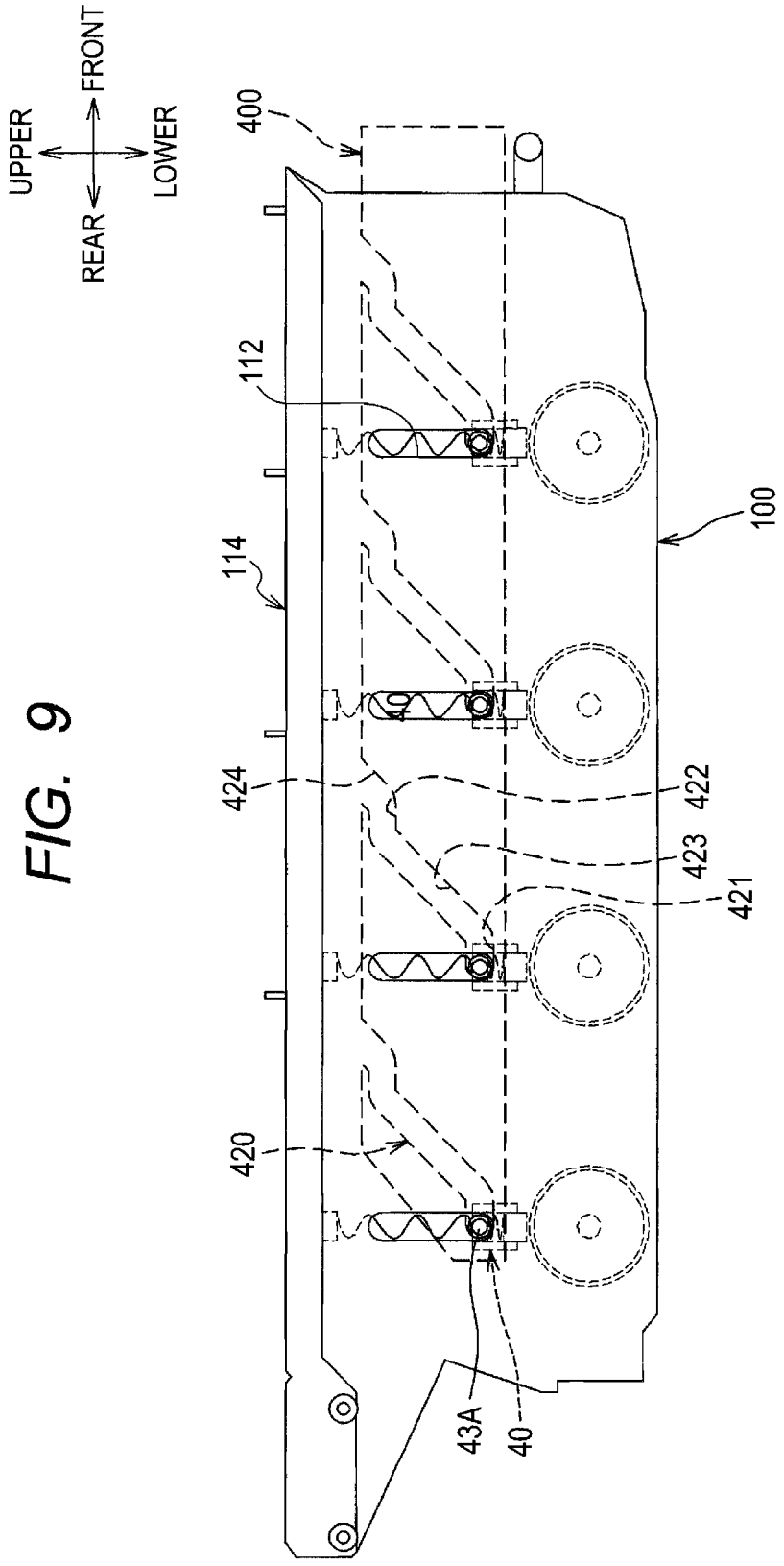
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FIG. 10

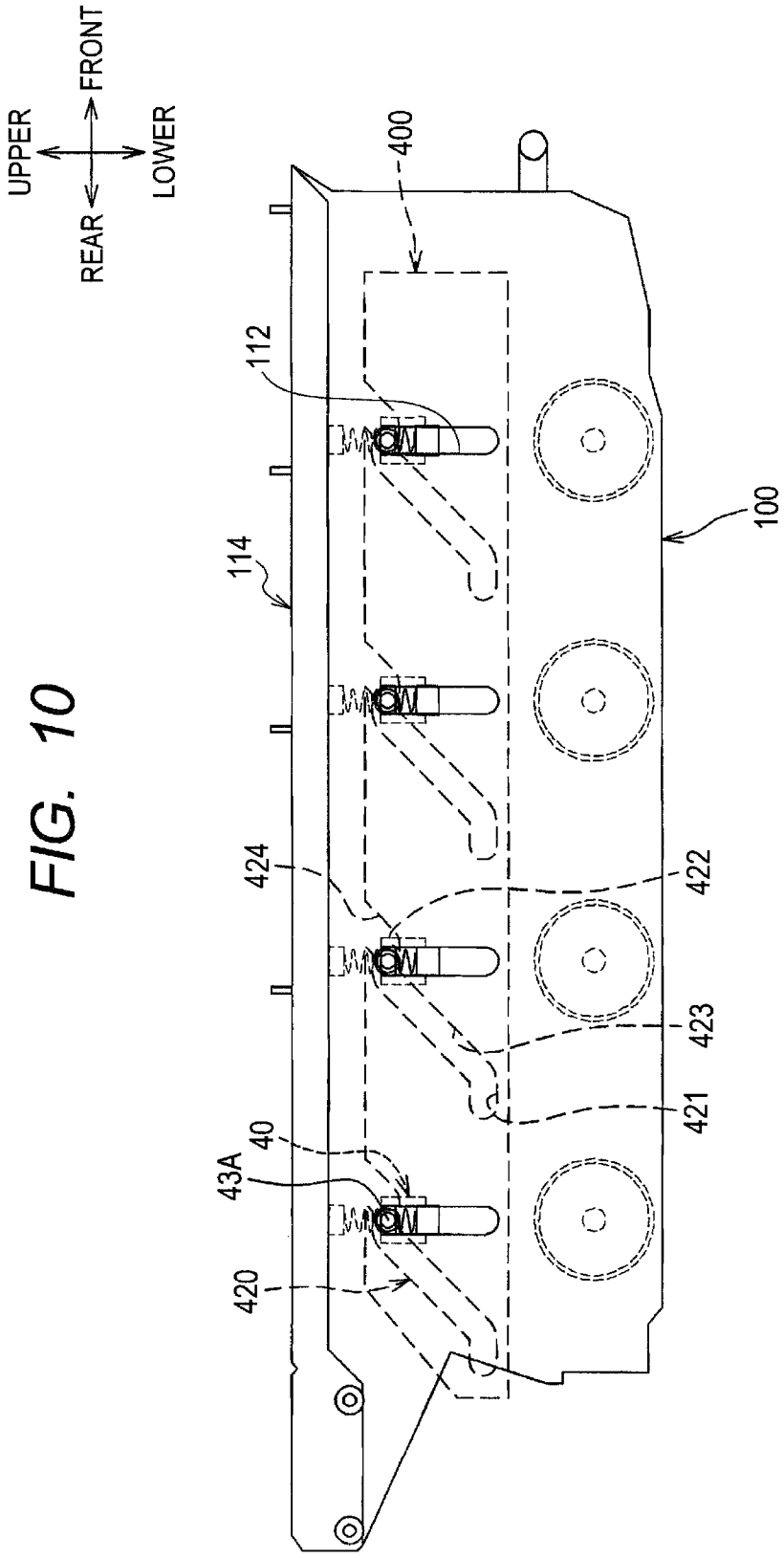
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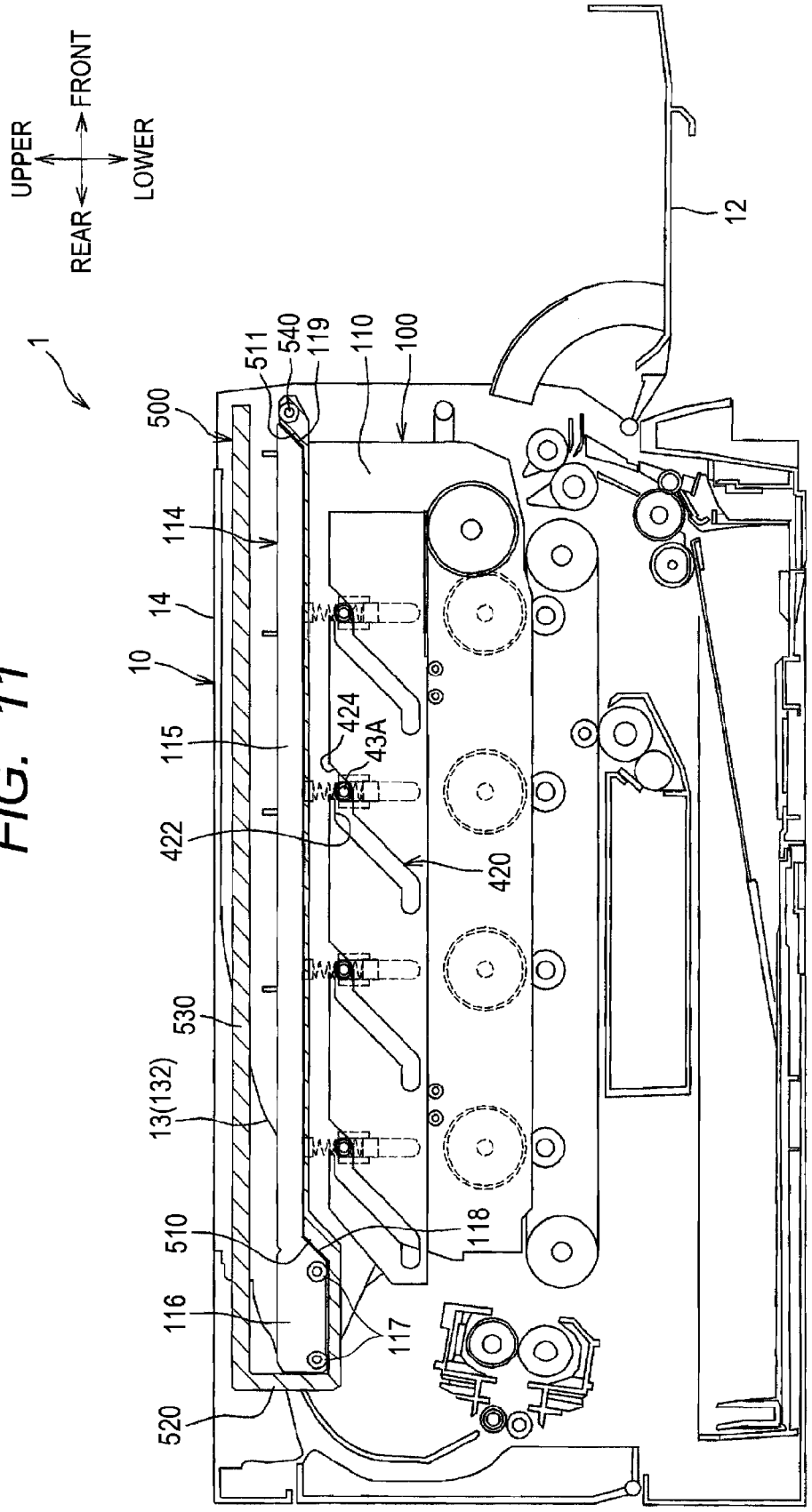
FIG. 11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511
540
119
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114
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10
115
424
43A
422
420
530
13(132)
510
118
116
117
520

FIG. 12

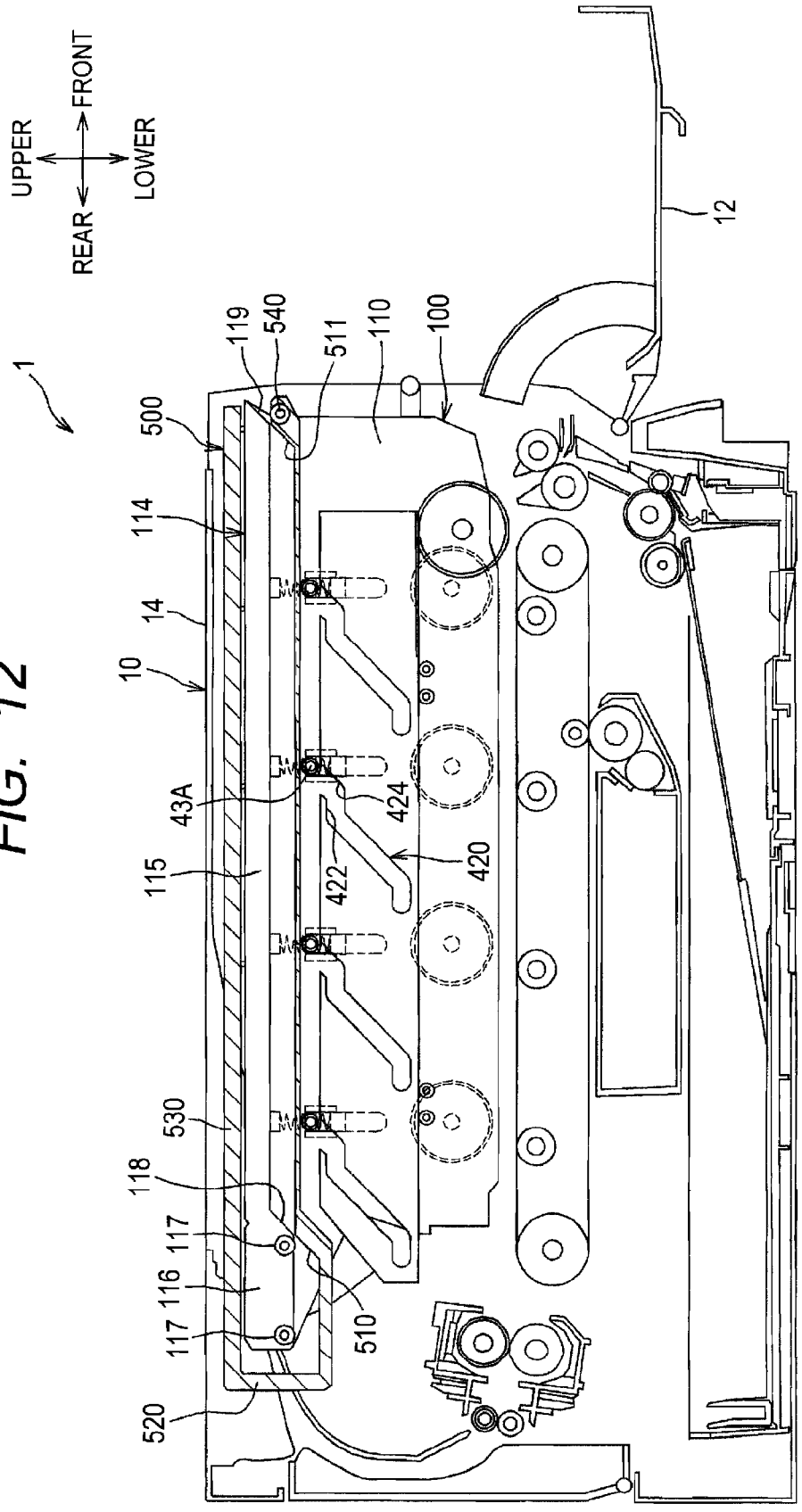
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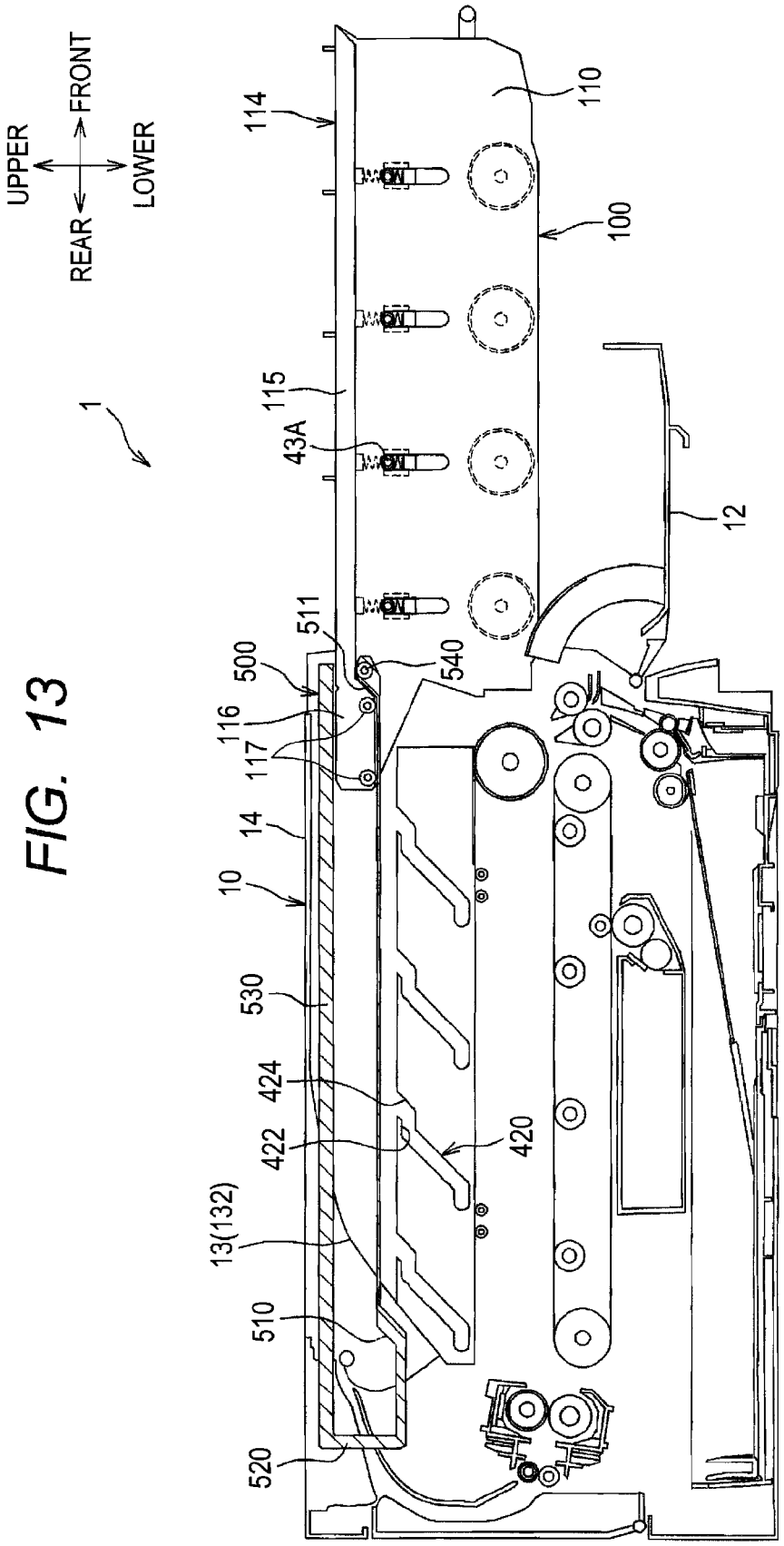
FIG. 13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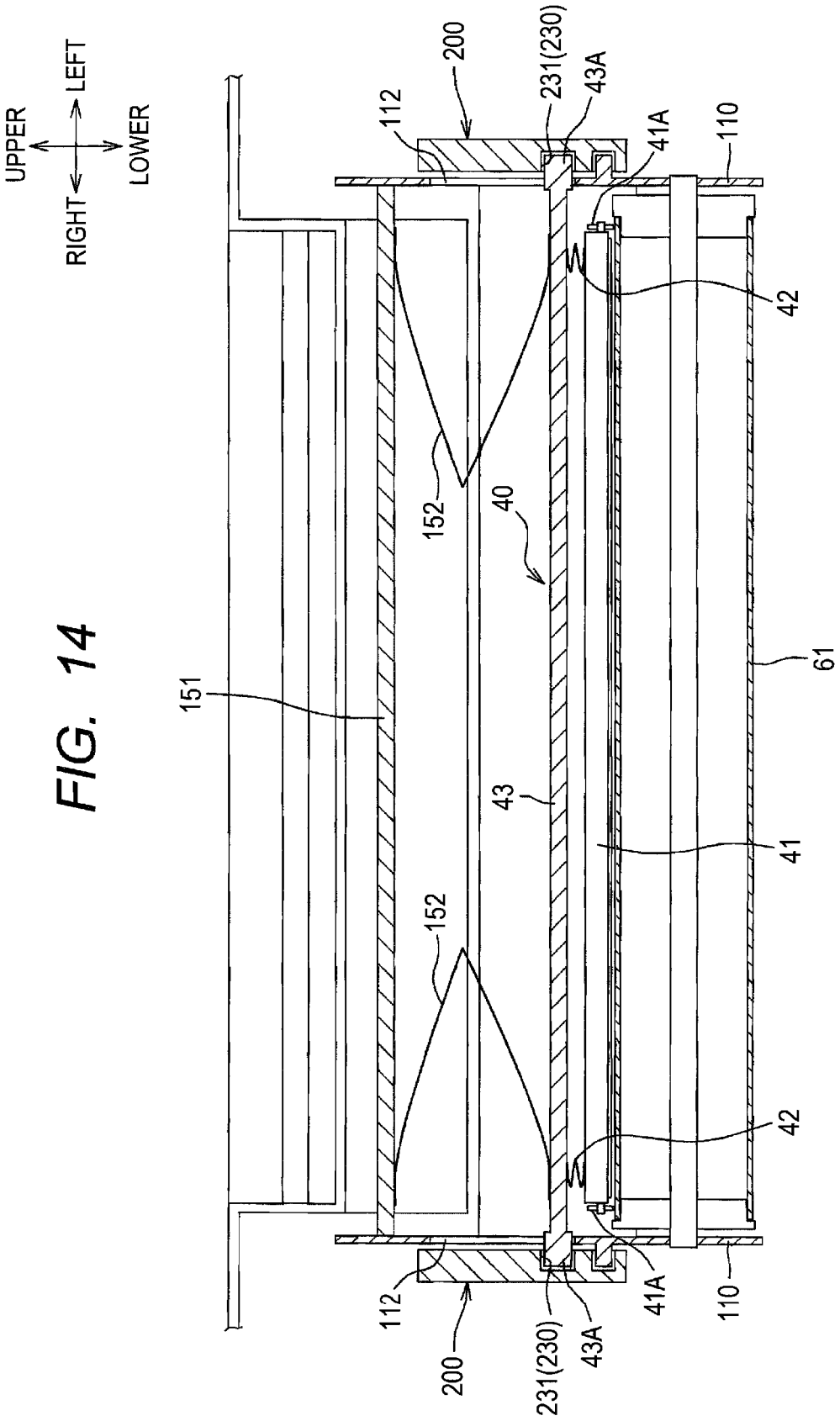
424
422
420
13(132)
510
520

FIG. 14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43
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152
42
112
41A
110
200
231(230)
43A

IMAGE FORMING APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/349,781 filed Jan. 13, 2012, which claims priority from Japanese Patent Application No. 2011-005923 filed Jan. 14, 2011, the disclosures of which are incorporated herein by reference.

TECHNICAL FIELD

The invention relates to an image forming apparatus.

BACKGROUND

An image forming apparatus is conventionally known that includes a plurality of photosensitive drums and a plurality of LED heads arranged above the plurality of photosensitive drums.

SUMMARY

In the above-mentioned image forming apparatus, when the plurality of photosensitive drums and the plurality of LED heads are moved to outside an apparatus main body, there is a possibility that the plurality of LED heads interfere with another member or a user touches an exposing surface of the LED head, which adversely affects printing.

In view of the foregoing, it is an object of the invention to provide an image forming apparatus that is configured to protect an exposing member such as an LED head.

In order to attain the above and other objects, the invention provides an image forming apparatus. The image forming apparatus includes an apparatus main body, a plurality of photosensitive drums, a plurality of exposing members, and a photosensitive-drum supporting member. The apparatus main body has an opening. The plurality of photosensitive drums each has both ends in an axial direction. The plurality of exposing members is each configured to expose a corresponding one of the plurality of photosensitive drums to light for forming an electrostatic latent image on the corresponding one of the plurality of photosensitive drums. The photosensitive-drum supporting member has a pair of side walls confronting the both ends of each of the plurality of photosensitive drums. The photosensitive-drum supporting member is configured to support the plurality of photosensitive drums between the pair of side walls. The photosensitive-drum supporting member is configured to move between: a stowed position at which the photosensitive-drum supporting member is stowed within the apparatus main body; and a moved position at which the photosensitive-drum supporting member is moved from the stowed position to outside the apparatus main body through the opening. The plurality of exposing members is provided at the photosensitive-drum supporting member such that the plurality of exposing members is configured to move between: an exposing position at which each of the plurality of exposing members is adjacent to the corresponding one of the plurality of photosensitive drums; and a retracted position at which each of the plurality of exposing members is separated from the corresponding one of the plurality of photosensitive drums and is engaged by an engaging part. The plurality of exposing members is accommodated within the photosensitive-drum supporting member both at the exposing position and at the retracted position.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments in accordance with the invention will be described in detail with reference to the following figures wherein:

FIG. **1** is a vertical cross-sectional view showing a color printer embodying an image forming apparatus according to a first embodiment of the invention;

FIG. **2** is a vertical cross-sectional view showing a drawer and a guide member in a state where a front cover is at a closed position;

FIG. **3** is a vertical cross-sectional view showing the drawer and the guide member in a state where a front cover is at an open position;

FIG. **4** is a vertical cross-sectional view showing a state in which the drawer is pulled out to outside an apparatus main body;

FIG. **5** is a vertical cross-sectional view showing a relationship between the drawer and process cartridges;

FIG. **6** is a vertical cross-sectional view of an LED array as viewed from the rear;

FIG. **7** is a vertical cross-sectional view showing a color printer embodying an image forming apparatus according to a second embodiment of the invention, in a state where a front cover is at a closed position;

FIG. **8** is a vertical cross-sectional view showing the color printer of FIG. **7**, in a state where a front cover is at an open position;

FIG. **9** is a side view showing a relationship between a linear-movement cam and the drawer in a state where the front cover is at the closed position;

FIG. **10** is a side view showing a relationship between the linear-movement cam and the drawer in a state where the front cover is at the open position;

FIG. **11** is a vertical cross-sectional view showing a state in which the drawer is located at a stowed position;

FIG. **12** is a vertical cross-sectional view showing a state in which the drawer is moved up in a diagonally front upper direction from the position shown in FIG. **11**;

FIG. **13** is a vertical cross-sectional view showing a state in which the drawer is pulled out to a moved position; and

FIG. **14** is a vertical cross-sectional view showing urging members according to a modification.

DETAILED DESCRIPTION

First Embodiment

A color printer embodying an image forming apparatus according to a first embodiment of the invention will be described while referring to FIGS. **1** through **6**.

In the following description, the expressions "front", "rear", "upper", "lower", "right", and "left" are used to define the various parts when the color printer is disposed in an orientation in which it is intended to be used by a user. That is, in FIG. **1**, the right side on the drawing sheet is defined as the "front" side, the left side on the drawing sheet is defined as the "rear" side, the far side in a direction perpendicular to the drawing sheet is defined as the "right" side, and the near side in the direction perpendicular to the drawing sheet is defined as the "left" side. Further, the upper and lower direction on the drawing sheet is defined as the "upper-lower direction". Also, in cross-sectional views, hatching is provided in especially necessary areas for simplicity.

As shown in FIG. **1**, a color printer **1** includes, within an apparatus main body **10**, a paper feeding section **20** that feeds paper P (recording sheet) and an image forming section **30**

that forms an image by superposing images corresponding to respective colors of K (black), C (cyan), M (magenta), Y (yellow) on fed paper P.

An opening **11** (see FIG. **3**) is formed at a front wall of the apparatus main body **10**. A front cover **12** is also provided pivotally at the front wall so as to open and close the opening **11**. Specifically, the front cover **12** is pivotally movable (displaceable) between a closed position (the position shown in FIG. **1**) at which the opening **11** is closed and an open position (the position shown in FIG. **3**) at which the opening **11** is opened.

The paper feeding section **20** includes a paper feeding tray **21** that accommodates paper P and a paper conveying device **22** that conveys paper P from the paper feeding tray **21** to the image forming section **30**.

The image forming section **30** includes four LED arrays **40** (an example of a plurality of exposing members), four process cartridges **50**, a transfer unit **70**, and a fixing unit **80**.

Each LED array **40** includes a semiconductor chip and a plurality of LEDs so as to expose a corresponding one of photosensitive drums **61** described later to light along a main scanning direction (the axial direction of the photosensitive drum **61**). The four LED arrays **40** for respective colors are arranged above and adjacent to the respective photosensitive drums **61** so as to correspond to the four photosensitive drums **61** for the respective colors, and are supported by a drawer **100** described later (an example of a photosensitive-drum supporting member).

The process cartridges **50** are arranged in the front-rear direction. Each of the process cartridges **50** includes a developing cartridge **51** and a drum cartridge **60** disposed below the developing cartridge **51**, and is detachably mounted on the drawer **100**.

Each of the developing cartridges **51** includes a toner accommodating container **52** that accommodates toner (an example of developer), a developing roller **53** that supplies toner within the toner accommodating container **52** to the photosensitive drum **61**, a supply roller and a layer-thickness regulating blade (both shown in the drawing, but reference signs are omitted), and the like. Four developing cartridges **51** accommodate therein toner in the respective colors and are arranged adjacent to and diagonally forward above the respective photosensitive drums **61** so as to correspond to the four photosensitive drums **61**. The developing cartridge **51** is detachably mounted on the drum cartridge **60**.

Each drum cartridge **60** includes the photosensitive drum **61**, a well-known charger (shown in the drawing, but reference signs are omitted), and the like. The four drum cartridges **60** are detachably mounted on the drawer **100** described later.

The transfer unit **70** is provided between the paper feeding section **20** and the photosensitive drums **61**. The transfer unit **70** includes an endless conveying belt **71** looped around a plurality of rollers, and four transfer rollers **72**. The conveying belt **71** is disposed below the photosensitive drums **61** so as to confront the plurality of photosensitive drums **61**. The transfer rollers **72** are arranged inside the conveying belt **71** so as to sandwich the conveying belt **71** with the respective photosensitive drums **61**.

The fixing unit **80** is disposed at the rear side of the process cartridges **50** and the transfer unit **70**. The fixing unit **80** includes a heat roller **81** and a pressure roller **82** arranged to confront the heat roller **81** for pressing the heat roller **81**.

In the image forming section **30** having the above-described configuration, first, a surface of each photosensitive drum **61** is charged uniformly by the charger, and is then exposed to light by the LED array **40**. With this operation, an electric potential of exposed portions decreases, and an electrostatic latent image is formed on each photosensitive drum **61** based on image data. Subsequently, toner is supplied to the electrostatic latent image from the developing roller so that a toner image is borne on the photosensitive drum **61**.

Next, the paper P conveyed onto the conveying belt **71** passes between the photosensitive drums **61** and the respective transfer rollers **72**, so that the toner image formed on each photosensitive drum **61** is transferred onto the paper P. Then, the paper P passes between the heat roller **81** and the pressure roller **82**, and the toner image transferred onto the paper P is thermally fixed onto the paper P.

Then, the paper P subjected to thermal fixing by the fixing unit **80** is discharged outside of the apparatus main body **10** by discharge rollers **90** arranged at the downstream side of the fixing unit **80**, and is placed on a discharge tray section **13** formed at an upper wall **14** of the apparatus main body **10**. Here, the discharge tray section **13** is formed to be concave downward at a center part of the upper wall **14** of the apparatus main body **10** in the left-right direction, so that spaces are formed in the apparatus main body **10** at the left and right sides (the both axial ends of the photosensitive drum **61**) of the discharge tray section **13**.

Specifically, the discharge tray section **13** includes a first wall **131** and a second wall **132**. The first wall **131** extends downward and perpendicularly from the upper wall **14** of the apparatus main body **10**, and has a discharge opening **13**A of paper P. The second wall **132** extends in a diagonally front upper direction from the lower end of the first wall **131** toward the upper wall **14**, and has an arc shape that is convex upward in cross-section.

Structure of Drawer **100** and Surrounding Parts

Next, the structure of the drawer **100** and surrounding parts will be described in detail.

As shown in FIGS. **2** through **4**, the drawer **100** is movable in the front-rear direction between: a stowed position at which the drawer **100** is stowed within the apparatus main body **10** (the position shown in FIG. **3**); and a moved position at which the drawer **100** is moved to outside the apparatus main body **10** from the stowed position through the opening **11** of the apparatus main body **10** (the position shown in FIG. **4**). In other words, the drawer **100** can be pulled out in a direction in which paper P is discharged in the discharge tray section **13** (that is, in the forward direction).

Specifically, the drawer **100** moves upward when the front cover **12** is opened and is configured to be pulled out forward through the opening **11** from the position moved upward. That is, the drawer **100** is movable in the vertical direction (the optical axis direction of the LED array **40**), and is also movable in the front-rear direction (the direction in which the plurality of photosensitive drums **61** is arranged).

Each LED array **40** within the drawer **100** moves upward and downward in conjunction with forward and rearward movement of the drawer **100**. More specifically, each LED array **40** is disposed at an exposing position adjacent to the photosensitive drum **61** (the position shown in FIG. **3**) when the drawer **100** is located at the stowed position, and is disposed at a retracted position at which the LED array **40** is retracted (separated) from the photosensitive drum **61** and is engaged by an engaging part **112**A (an upper edge of an elongated hole **112** described later) (the position shown in FIG. **4**) when the drawer **100** is located at the moved position.

Each LED array **40** is accommodated within the drawer **100** both at the exposing position and at the retracted position. That is, each LED array **40** does not protrude from the drawer

100 at the exposing position or at the retracted position. With this configuration, each LED array 40 can be protected from a user and the like.

Specifically, the drawer 100, a left and right pair of guide members 200 (an example of an action member), and a left and right pair of interlocking mechanisms 300 are provided at the apparatus main body 10.

The pair of guide members 200 supports the drawer 100 such that the drawer 100 is configured to move linearly in the front-rear direction. The pair of interlocking mechanisms 300 moves the guide members 200 in a diagonally front upper direction or in a diagonally rear lower direction in conjunction with an open/close operation of the front cover 12.

Note that members arranged at the left and right sides, such as the guide members 200 and the interlocking mechanisms 300, have bilaterally symmetrical structures. Thus, in the following descriptions, a structure at either one of the left and right sides will be described, and descriptions of a structure at the other side will be omitted.

The drawer 100 has a pair of side walls 110 confronting each other in the left-right direction (the axial direction of the photosensitive drum 61), and supports the plurality of process cartridges 50 (the plurality of photosensitive drums 61) and the plurality of LED arrays 40 between the pair of side walls 110. Further, as shown in FIG. 5, the front end parts of the pair of side walls 110 are connected by a front wall 120, whereas the rear end parts of the pair of side walls 110 are connected by a rear wall 130. A handle section 140 gripped by a user and having a U-shape in cross-section is provided at the front surface of the front wall 120.

Arc-like grooves 111 is formed on the inner surface of each side wall 110 for guiding the process cartridges 50 to respective exposed positions (the positions at which the photosensitive drums 61 are exposed to light by the LED arrays 40). With this configuration, each process cartridge 50 is configured to be moved in an arc shape relative to the drawer 100 and mounted on or dismounted from the drawer 100. Because the LED array 40 is disposed directly above the photosensitive drum 61 (FIG. 5), the space can be used efficiently by mounting and dismounting the process cartridge 50 in an arc shape along the arc-like groove 111 as described above.

The pairs of elongated holes 112 (an example of a penetration section) are formed in the side walls 110 for supporting each LED array 40 such that the LED array 40 is configured to move vertically. Each elongated hole 112 is formed to extend vertically, and engages an action receiving section 43A described later (see FIG. 6) of the LED array 40 in order to guide the LED array 40 between the exposing position and the retracted position.

As shown in FIG. 6, the LED array 40 includes an LED head 41 having a plurality of LEDs, a pair of coil springs 42 that urges the LED head 41 toward the photosensitive drum 61, and a support frame 43 that supports the LED head 41 via the coil springs 42. The support frame 43 has an elongated shape in the left-right direction. The pair of action receiving section 43A is provided at the both ends of the support frame 43. The action receiving section 43A penetrate the respective elongated holes 112 and protrude outward from the respective side walls 110 in the left-right direction.

The support frame 43 is supported by the drawer 100 via tension coil springs 150 (an example of an urging member). Specifically, the tension coil springs 150 are arranged between a support wall 151 and the support frame 43 so as to constantly urge the LED array 40 in a direction away from the photosensitive drum 61. Here, the support wall 151 is fixed to the pair of side walls 110 in a manner bridging the pair of side walls 110.

As shown in FIGS. 2 through 4, each action receiving section 43A protruding outward from each side wall 110 contacts the pair of guide members 200 provided outside each side wall 110, so that the action receiving section 43A is pressed upward and downward by the guide member 200. The guide members 200 are provided at the apparatus main body 10, and support the drawer 100 such that the drawer 100 is configured to move in the front-rear direction. In other words, the guide members 200 are relatively movable relative to the drawer 100.

Specifically, the guide member 200 includes a main body section 210 that has a plate shape elongated in the front-rear direction, a drawer guide groove 220 (an example of a support-member guide section), and a guide groove 230 (an example of a guide section).

The main body section 210 is disposed to face the side wall 110 of the drawer 100. A protruding pin 211 protruding outward in the left-right direction is provided at each of the front lower part and the rear lower part of the main body section 210. The pair of front-side protruding pins 211 is movably supported by a pair of arc-like grooves 15 formed at a front part of left and right side frames 16 of the apparatus main body 10. The pair of rear-side protruding pins 211 is also movably supported by another pair of arc-like grooves 15 formed at a rear part of the left and right side frames 16.

With this configuration, the main body section 210 is movable between the position shown in FIG. 2 and the position shown in FIG. 3. More specifically, the main body section 210 is movably supported by the apparatus main body 10, such that the photosensitive drum 61 can move between: a contact position at which the photosensitive drum 61 is in contact with the conveying belt 71; and a separated position at which the photosensitive drum 61 is separated (spaced away) from the conveying belt 71. That is, in the present embodiment, the guide members 200 and the grooves 15 formed in the apparatus main body 10 serve as a separating mechanism that supports the drawer 100 via the guide members 200 such that the drawer 100 is configured to move at least vertically (upward and downward).

The drawer guide groove 220 is a groove that is formed in the front-rear direction, and that supports the drawer 100 such that the drawer 100 is configured to move in the front-rear direction. Specifically, the drawer guide groove 220 supports a pair of engaging pins (protrusions) 113A and one engaging pin (protrusion) 113B. The pair of engaging pins 113A is provided at the rear side of each side wall 110 of the drawer 100. The engaging pin 113B is provided at the front side of each side wall 110.

The drawer guide groove 220 is provided with a pair of restricting surfaces 221 and 222 that restricts movement of the pair of engaging pins 113A in the front-rear direction. With this configuration, forward and rearward movement of the drawer 100 relative to the guide member 200 is restricted, so that the drawer 100 is positioned at the stowed position and at the moved position.

Note that the engaging pin 113B provided at the front side of the side wall 110 of the drawer 100 is shorter than each of the pair of engaging pins 113A, so that the engaging pin 113B does not engage the restricting surface 221. That is, the engaging pin 113B is configured not to engage the restricting surface 221 and not to drop off the drawer guide groove 220.

The guide groove 230 is a groove for guiding the action receiving section 43A from the retracted position to the exposing position at a mounting operation of the drawer 100. The guide groove 230 has a closed rear end and a front end that opens to outside. Specifically, the guide groove 230 has a engaging section 231, an allowing section 232, and a slope

section **233** (sloped groove). The engaging section **231** engages the action receiving section **43**A when the LED array **40** is located at the exposing position. The allowing section **232** allows movement of the action receiving section **43**A in the front-rear direction when the LED array **40** is located at the retracted position. The slope section **233** connects the engaging section **231** with the allowing section **232**.

The engaging section **231** is formed as an elongated groove extending in the front-rear direction. An upper edge of the engaging section **231** restricts upward movement of the action receiving section **43**A. Specifically, when the LED array **40** is located at the exposing position (a position at which guide rollers **41**A provided rotatably at the LED head **41** are in contact with the photosensitive drum **61** as shown in FIG. **6**), the LED head **41** is urged downward by the coil springs **42**, and the action receiving sections **43**A are urged upward by the coil springs **42** and the tension coil springs **150**. Because the action receiving section **43**A engages the upper edge of the engaging section **231**, the LED array **40** is positioned at the exposing position, and is also urged toward the photosensitive drum **61** at appropriate urging force.

The allowing section **232** is formed as an elongated groove extending in the front-rear direction.

The slope section **233** is formed as an elongated groove that is inclined downward toward the rear. With this configuration, as the drawer **100** is mounted onto the guide members **200** (the apparatus main body **10**), the action receiving section **43**A is pressed downward by the upper edge of the slope section **233**, and the LED array **40** moves downward to the exposing position. Further, as the drawer **100** is pulled out of the guide members **200** (the apparatus main body **10**), the action receiving section **43**A is pressed upward by the lower edge of the slope section **233** or is urged upward by the urging force of the tension coil spring **150**, and the LED array **40** moves upward to the retracted position.

By moving the guide members **200** in conjunction with an open/close operation of the front cover **12**, the interlocking mechanisms **300** displaces the guide members **200** (the photosensitive drums **61**) from the contact position to the separated position when the front cover **12** is displaced from a closed position to an open position. Specifically, the interlocking mechanism **300** includes a fan-shape member **310** fixed to the front cover **12**, and a link member **320** linking the guide member **200** with the fan-shape member **310**.

The fan-shape member **310** has a fan shape of which the center is a swing shaft **12**A of the front cover **12**. A pair of the fan-shape members **310** is provided at the left and right sides of the lower end part of the front cover **12**, respectively.

The first link member **320** has one end that is pivotally coupled to the front-side protruding pin **211** of the guide member **200** and another end that is pivotally coupled to the fan-shape member **310**.

With this configuration, as the front cover **12** is opened, the guide member **200** is pulled forward by the front cover **12** via the link member **320** and the fan-shape member **310**, so that the guide member **200** moves in a diagonally front upper direction along the arc-like groove **15**. Further, as the front cover **12** is closed, the guide member **200** is pushed rearward by the front cover **12** via the link member **320** and the fan-shape member **310**, so that the guide member **200** moves in a diagonally rear lower direction along the arc-like groove **15**.

Further, the rear part of the drawer **100** and the rear part of the guide member **200** are arranged in the spaces formed at the left and right sides of the discharge tray section **13**. More specifically, the rear part of the drawer **100** and the rear part of the guide member **200** are arranged at positions that overlap the discharge tray section **13** as viewed from the left-right direction in a state where the front cover **12** is closed and printing can be performed.

With this configuration, the position of the upper wall **14** of the apparatus main body **10** can be lowered without changing depth of the discharge tray section **13**, thereby enabling the apparatus main body **10** to be downsized in the vertical direction. Further, by arranging a part of the drawer **100** and the like in the spaces formed at the left and right sides of the discharge tray section **13** in this way, the front upper part of the drawer **100** (the upper part of the process cartridges **50**) and the front upper part of the guide members **200** are arranged in a space below the second wall **132** of the discharge tray section **13** and the upper wall **14**. Thus, the space below the second wall **132** of the discharge tray section **13** and the upper wall **14** can be utilized efficiently.

According to the present embodiment, the following effects can be obtained.

The LED arrays **40** are accommodated within the drawer **100** both at the exposing position and at the retracted position. This configuration suppresses interference between the LED arrays **40** and other members, and can prevent the user from touching the LED array **40** by mistake.

The guide members **200** for vertically moving the LED arrays **40** are provided at the outside of the pair of side walls **110**. Thus, the structure can be simplified, compared with the configuration where a linear-movement cam for vertically moving the LED arrays **40** is provided at the inside of the side walls.

The elongated holes **112** allowing penetration of the action receiving section **43**A and engaging the action receiving section **43**A are formed in the side wall **110** for guiding the LED array **40** between the exposing position and the retracted position. Thus, the structure can be simplified, compared with the configuration where a hole from which an action receiving section protrudes and a member for guiding the action receiving section are provided separately.

A hole (the elongated hole **112**) is adopted as a penetration part through which the action receiving section **43**A penetrates. Here, the "hole" means an opening of which the circumference is closed. Thus, strength of the side wall **110** can be increased, for example, compared with the configuration where a penetration part opened to an edge of the side wall (i.e., a notch-like shape) is formed.

Because the guide members **200** are provided at the apparatus main body **10**, the weight of the drawer **100** can be reduced, and the operability can be improved. Further, when the drawer **100** is pulled out to the moved position, the risk that the color printer **1** falls toward the front side can be reduced.

Two grooves (the drawer guide groove **220** and the guide groove **230**) are formed in one guide member **200**. Thus, the structure can be simplified, for example, compared with the structure where each groove is formed in separate members.

The guide members **200** supporting the drawer **100** are moved vertically, enabling the drawer **100** to be pushed in and pulled out straightly and linearly in parallel with the belt surface of the conveying belt **71**. Thus, the operability of the drawer **100** can be improved, for example, compared with the structure where the drawer is lifted diagonally upward and pulled out.

The front cover **12** and the guide members **200** are operated in an interlocking manner. Thus, mounting and dismounting operations of the drawer **100** can be performed more easily, for example, compared with the structure where the front cover **12** is opened and then the guide members **200** are moved vertically by hand.

The tension coil springs **150** are provided at the drawer **100** for urging the LED array **40** away from the photosensitive drum **61**. Thus, when the drawer **100** is dismounted from the apparatus main body **10**, the LED array **40** can be reliably moved to the retracted position with the urging force of the tension coil springs **150**.

Second Embodiment

A color printer embodying an image forming apparatus according to a second embodiment of the invention will be described while referring to FIGS. **7** through **13**, wherein like parts and components are designated by the same reference numerals to avoid duplicating description.

As shown in FIGS. **7** through **10**, a color printer of the second embodiment includes a linear-movement cam **400** and a fixed guide member **500** provided at the apparatus main body **1**, instead of the guide member **200** and the interlocking mechanism **300** in the first embodiment. The linear-movement cam **400** (an example of an action member) vertically moves the LED array **40** between the exposing position and the retracted position. The fixed guide member **500** supports the drawer **100** such that the drawer **100** is configured to move in the front-rear direction.

The linear-movement cam **400** is configured to move in the front-rear direction (the moving direction of the drawer **100**). The linear-movement cam **400** mainly includes a main body section **410** having a plate shape elongated in the front-rear direction, four cam grooves **420** (an example of a guide section) formed in the main body section **410** at predetermined intervals in the front-rear direction, and a rack gear section **430** provided at a front part of the lower end of the main body section **410**.

The main body section **410** is arranged between the side wall **110** of the drawer **100** and the side frame **16** of the apparatus main body **10** at each of the left and right sides, such that the main body section **410** faces the side wall **110** and the side frame **16**. The main body section **410** is supported by a plurality of support rollers **16**A rotatably provided at the side frame **16**, such that the main body section **410** is configured to move forward and rearward. Further, holding members (for example, L-shaped members supporting the upper and lower ends of the main body section **410**; not shown) are provided at the side frame **16** for holding the main body section **410** in a state facing the side frame **16**.

The four cam grooves **420** has an engaging section **421**, an allowing section **422**, and a slope section **423** having the same function as each section of the guide groove **230** in the first embodiment. Each of the cam grooves **420** is inclined downward toward the rear side. In addition, the cam groove **420** has a mount-dismount section **424** that extends from the allowing section **422** in a diagonally front upper direction and that opens at the upper end of the main body section **410**.

With this configuration, when the linear-movement cam **400** is moved forward from the position shown in FIG. **10**, the action receiving section **43**A is pushed downward by the upper edge of the slope section **423** and, as shown in FIG. **9**, the LED arrays **40** move downward to the exposing position. On the other hand, when the linear-movement cam **400** is moved rearward from the position shown in FIG. **9**, the action receiving section **43**A is pushed upward by the lower edge of the slope section **423** or is urged upward by the urging force of the tension coil spring **150** and, as shown in FIG. **10**, the LED arrays **40** move upward to the retracted position.

Further, when the drawer **100** is moved in a diagonally front upper direction at the position shown in FIG. **10**, each action receiving section **43**A passes the mount-dismount section **424** and gets out of the cam groove **420**.

As shown in FIGS. **7** and **8**, the rack gear section **430** includes a plurality of gear teeth arranged in the front-rear direction, so that force generated by an open/close operation of the front cover **12** is transmitted to the rack gear section **430** via an interlocking mechanism **600**.

The interlocking mechanism **600** interlocks the linear-movement cam **400** with the front cover **12**, such that the LED arrays **40** move from the exposing position to the retracted position when the front cover **12** is displaced from the closed position to the open position. Specifically, the interlocking mechanism **600** includes an arc-like gear member **610** and a gear **620**. The arc-like gear member **610** is integrally provided on an inner surface of the front cover **12**. The gear **620** is configured to meshingly engage the arc-like gear member **610** and the rack gear section **430**.

The arc-like gear member **610** has an arc shape of which the center is the swing center of the front cover **12**. A gear section **611** is provided at a part of the outer circumferential surface of the arc-like gear member **610** for meshingly engaging the gear **620**. The gear **620** is rotatably provided at the side frame **16** of the apparatus main body **10**.

Because the interlocking mechanism **600** is configured in this manner, when the front cover **12** is opened or closed, the force is transmitted to the rack gear section **430** via the arc-like gear member **610** and the gear **620**, and the linear-movement cam **400** moves in the front-rear direction. More specifically, when the front cover **12** is closed, the action receiving section **43**A moves rearward relative to the linear-movement cam **400** and moves along the cam groove **420** so that the LED array **40** moves downward to the exposing position. On the other hand, when the front cover **12** is opened, the action receiving section **43**A moves forward relative to the linear-movement cam **400** and moves along the cam groove **420** so that the LED array **40** moves upward to the retracted position. Hence, the user only need to open or close the front cover **12** in order to move the LED arrays **40** upward or downward automatically. Thus, the operability of the drawer **100** can be improved compared with the structure where the LED arrays **40** are moved manually.

As shown in FIGS. **11** through **13**, a guided section **114** protruding outward in the left-right direction is provided at the upper end of each side wall **110** of the drawer **100**. The guided section **114** is supported by the fixed guide member **500** such that the guided section **114** is configured to move forward and rearward. The guided section **114** includes an elongated section **115**, a protruding section **116**, and wheels **117**. The elongated section **115** extends in the front-rear direction. The protruding section **116** is integrally provided at the rear end of the elongated section **115** and protrudes downward from the elongated section **115**. The wheels **117** are rotatably provided at the protruding section **116**.

A step surface **118** provided between the lower surface of the protruding section **116** and the lower surface of the elongated section **115** is a slope surface that is inclined in a diagonally front upper direction. A lower surface **119** at the front end of the elongated section **115** is also a slope surface that is inclined in a diagonally front upper direction. More specifically, the step surface **118** and the lower surface **119** are inclined at the same angle as the mount-dismount section **424** of the above-described cam groove **420**.

On the other hand, the fixed guide member **500** includes a lower wall section **510**, a rear wall section **520**, an upper wall section **530**, and a wheel **540**. The lower wall section **510** has a shape that follows the shape of the lower surface of the guided section **114**. The rear wall section **520** is configured to

abut the rear end of the guided section **114** in order to position the drawer **100** at the stowed position. The upper wall section **530** faces the upper surface of the guided section **114**. The wheel **540** is rotatably provided at the front end of the lower wall section **510**.

The linear-movement cam **400**, the fixed guide member **500**, and the like have the above-described configurations. Thus, in order to pull the drawer **100** out of the apparatus main body **10**, when the user opens the front cover **12**, the linear-movement cam **400** moves rearward and the LED arrays **40** move to the retracted position. Next, when the user pulls the drawer **100**, the wheels **117** get over the step of the lower wall section **510**, and the front end of the guided section **114** gets over the wheel **540**. With this operation, the drawer **100** moves in a diagonally front upper direction, so that each photosensitive drum **61** separates from the conveying belt **71** and also each action receiving section **43**A gets out of the cam groove **420**.

Subsequently, the wheels **117** of the guided section **114** rolls on the upper surface of the lower wall section **510** (the surface located at the front side of the step), and the elongated section **115** of the guided section **114** is supported by the wheel **540**, thereby enabling the drawer **100** to be pulled out straight toward the front side. Then, when the protruding section **116** of the guided section **114** abuts a front end section **511** (a part protruding upward) of the lower wall section **510**, the drawer **100** is stopped at that position (the moved position).

In order to bring the drawer **100** back to the stowed position, when the user pushes the drawer **100**, the drawer **100** moves straight toward the rear side until the protruding section **116** of the guided section **114** reaches a concave portion at the rear end of the lower wall section **510** and, when the protruding section **116** reaches the concave portion, the drawer **100** moves in a diagonally rear lower direction. With this operation, when the protruding section **116** fits into the concave portion and abuts the rear wall section **520**, the drawer **100** is stopped at that position (the stowed position), and the action receiving section **43**A of each LED array **40** passes through the mount-dismount section **424** of the cam groove **420** and gets into the allowing section **422**. Subsequently, when the user closes the front cover **12**, the linear-movement cam **400** moves forward, and the LED arrays **40** move to the exposing position.

With the structure of the above-described second embodiment, because the LED arrays **40** can be moved upward and downward within the drawer **100**, the effects similar to those in the first embodiment can be obtained.

In the second embodiment, the rear part of the fixed guide member **500**, the rear part of the guided section **114** of the drawer **100** supported by that part, and the rear part of the linear-movement cam **400** are arranged in the spaces at the left and right sides of the discharge tray section **13**. More specifically, the rear part of the fixed guide member **500** and the rear part of the drawer **100** are arranged at positions overlapping the discharge tray section **13** as viewed from the left-right direction in a state where the front cover **12** is closed and printing can be performed. Further, in a state where the front cover **12** is opened, the rear part of the linear-movement cam **400** is arranged at a position overlapping the discharge tray section **13** as viewed from the left-right direction.

With this configuration, the position of the upper wall **14** of the apparatus main body **10** can be lowered without changing depth of the discharge tray section **13**, thereby enabling the apparatus main body **10** to be downsized in the vertical direction. Further, by arranging a part of the drawer **100** and the like in the spaces formed at the left and right sides of the discharge tray section **13** in this way, the front part of the fixed guide member **500**, the front upper part of the drawer **100** (the upper part of the process cartridges **50**), and the front upper part of the linear-movement cam **400** are arranged in a space below the second wall **132** of the discharge tray section **13** and the upper wall **14**. Thus, the space below the second wall **132** of the discharge tray section **13** and the upper wall **14** can be utilized efficiently.

While the invention has been described in detail with reference to the above aspects thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the claims. In the following descriptions, like parts and components are designated by the same reference numerals to avoid duplicating description.

In the above-described embodiments, the LED array **40** is illustrated as an example of the exposing member. However, the invention is not limited to this configuration. For example, a large number of light emitting elements such as EL (electroluminescence) elements, phosphors, and the like may be arranged, and these light emitting elements may be lighted selectively in accordance with image data. Alternatively, a large number of light shutters made of liquid crystal elements, PLZT, or the like may be arranged for one light source, and open/close periods of the light shutters may be controlled selectively in accordance with image data so as to control light from the light source.

In the above-described embodiments, the elongated hole **112** (more specifically, the upper edge of the elongated hole **112**) formed in the side wall **110** is illustrated as an example of an engaging part for positioning the exposing member at the retracted position. However, the invention is not limited to this configuration. For example, a member separate from the side wall may be provided to engage the exposing member.

In the above-described first embodiment, the grooves (the guide groove **230** and the drawer guide groove **220**) are illustrated as examples of a guide section and a supporting-member guide section. However, the invention is not limited to this configuration. For example, a wall or the like having a shape similar to the grooves in the above-described embodiments may be provided.

In the above-described embodiments, the conveying belt **71** for conveying paper P between the conveying belt **71** and the photosensitive drum **61** is illustrated as an example of a belt. However, the invention is not limited to this configuration. For example, the belt may be an intermediate transfer belt onto which a toner image on the photosensitive drum is transferred.

In the above-described first embodiment, the guide member **200** and the grooves **15** formed in the apparatus main body **10** constitute a separating mechanism. However, the invention is not limited to this configuration. For example, a combination of a guide member and a link mechanism may constitute the separating mechanism.

In the above-described embodiments, the tension coil springs **150** are illustrated as an example of an urging member. However, the invention is not limited to this configuration. For example, leaf springs **152** shown in FIG. **14**, a torsion spring, a wire spring, or the like may be used.

In the above-described embodiments, the invention is applied to the color printer **1**. However, the invention is not limited to this configuration and, for example, may be applied to other kinds of image forming apparatuses such as a copier, a multifunction device, and the like.

What is claimed is:

1. An image forming apparatus comprising:

an apparatus main body;

a plurality of photosensitive drums each having both ends in an axial direction;

a photosensitive-drum supporting member configured to support the plurality of photosensitive drums, the photosensitive-drum supporting member being configured to move between: a stowed position at which the photosensitive-drum supporting member is stowed within the apparatus main body; and a moved position at which the photosensitive-drum supporting member is moved from the stowed position to outside the apparatus main body;

a discharge tray section provided at an upper part of the apparatus main body; and

a discharge roller provided to discharge a sheet onto the discharge tray section, the discharge tray section being sloped downward toward a side at which the discharge roller is provided,

wherein a lowest part of the discharge tray section is located at a lower position than a highest part of the photosensitive-drum supporting member.

2. The image forming apparatus according to claim 1, wherein the photosensitive-drum supporting member is located at a position that partially overlaps the discharge tray section as viewed from the axial direction in a state where the photosensitive-drum supporting member is at the stowed position.

3. The image forming apparatus according to claim 2, wherein the discharge tray section is formed to be concave downward at a center part, in the axial direction, of the upper part of the apparatus main body, so that spaces are formed in the apparatus main body at both sides of the discharge tray section in the axial direction.

4. The image forming apparatus according to claim 1, wherein the photosensitive-drum supporting member is configured to be pulled out in a direction in which the plurality of photosensitive drums is arranged.

5. The image forming apparatus according to claim 1, further comprising a plurality of exposing members each provided at the photosensitive-drum supporting member.

6. The image forming apparatus according to claim 5, wherein the photosensitive-drum supporting member has a pair of side walls confronting the both ends of each of the plurality of photosensitive drums, the photosensitive-drum supporting member being configured to support the plurality of photosensitive drums between the pair of side walls;

wherein each of the pair of side walls is formed with elongated holes each extending in a vertical direction;

wherein each of the plurality of exposing members has a support frame extending in the axial direction and having both ends engaged with the elongated holes; and

wherein the plurality of exposing members is configured to move vertically along the elongated holes within the photosensitive-drum supporting member.

7. The image forming apparatus according to claim 5, wherein the photosensitive-drum supporting member has a pair of side walls confronting the both ends of each of the plurality of photosensitive drums, the photosensitive-drum supporting member being configured to support the plurality of photosensitive drums between the pair of side walls;

wherein the plurality of exposing members is configured to move between: an exposing position at which each of the plurality of exposing members is adjacent to a corresponding one of the plurality of photosensitive drums; and a retracted position at which each of the plurality of exposing members is separated from the corresponding one of the plurality of photosensitive drums and is engaged by an engaging part; and

wherein the plurality of exposing members is accommodated within the photosensitive-drum supporting member both at the exposing position and at the retracted position.

8. The image forming apparatus according to claim 7, further comprising:

an action receiving section provided at each of the plurality of exposing members, the action receiving section protruding from the pair of side walls outward in the axial direction; and

an action member provided outside the pair of side walls such that the action member is configured to move relative to the photosensitive-drum supporting member, the action member being configured to contact the action receiving section so as to move the plurality of exposing members between the exposing position and the retracted position.

9. The image forming apparatus according to claim 8, wherein each of the pair of side walls is formed with a penetration section through which the action receiving section penetrates, the penetration section being configured to engage the action receiving section so as to guide each of the plurality of exposing members between the exposing position and the retracted position.

10. The image forming apparatus according to claim 9, wherein the penetration section is a hole.

11. The image forming apparatus according to claim 10, wherein the hole is an elongated hole extending in a vertical direction and having an upper edge; and

wherein the upper edge of the elongated hole serves as the engaging part that engages the action receiving section when each of the plurality of exposing members is located at the retracted position.

12. The image forming apparatus according to claim 8, wherein the action member is provided at the apparatus main body.

13. The image forming apparatus according to claim 12, wherein the action member is formed with a guide section configured to engage the action receiving section; and

wherein the guide section is configured to guide the action receiving section from the retracted position to the exposing position when the photosensitive-drum supporting member is mounted.

14. The image forming apparatus according to claim 13, wherein the action member comprises a supporting-member guide section that supports the photosensitive-drum supporting member such that the photosensitive-drum supporting member is configured to move.

15. The image forming apparatus according to claim 14, further comprising:

a belt provided at the apparatus main body and disposed below the plurality of photosensitive drums to confront the plurality of photosensitive drums; and

a separating mechanism configured to support the photosensitive-drum supporting member such that the action member is configured to move upward and downward, thereby moving the photosensitive-drum supporting member upward and downward, so that the plurality of photosensitive drums is configured to move between: a contact position at which the plurality of photosensitive drums is in contact with the belt; and a separated position at which the plurality of photosensitive drums is separated from the belt.

16. The image forming apparatus according to claim 15, further comprising:

a cover provided at the apparatus main body and configured to move between a closed position at which an opening of the apparatus main body is closed and an open position at which the opening is opened; and

an interlocking mechanism configured to interlock the cover with the separating mechanism such that the action member is displaced from the contact position to the separated position when the cover moves from the closed position to the open position.

17. The image forming apparatus according to claim **12**, wherein the photosensitive-drum supporting member comprises an urging member configured to urge a corresponding one of the plurality of exposing members in a direction away from a corresponding one of the plurality of photosensitive drums.

18. The image forming apparatus according to claim **1**, further comprising a plurality of process cartridges each comprising:

a developer container configured to accommodate developer;

a corresponding one of the plurality of photosensitive drums; and

a developing roller configured to supply the corresponding one of the plurality of photosensitive drums with the developer within the developer container,

wherein each of the plurality of process cartridges is configured to move in an arc shape relative to the photosensitive-drum supporting member when the each of the plurality of process cartridges is mounted and dismounted.

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